Biodegradation and metabolite transformation of pyrene by basidiomycetes fungal isolate armillaria Sp. F022

Abstract

Armillaria sp. F022 is a white-rot fungus isolated from a tropical rain forest in Indonesia that is capable of utilizing pyrene as a source of carbon and energy. Enzymes production during the degradation process by Armillaria sp. F022 was certainly related to the increase in biomass. In the first week after incubation, the growth rate rapidly increased, but enzyme production decreased. After 7 days of incubation, rapid growth was observed, whereas, the enzymes were produced only after a good amount of biomass was generated. About 63 % of pyrene underwent biodegradation when incubated with this fungus in a liquid medium on a rotary shaker (120 rpm, 25 °C) for 30 days; during this period, pyrene was transformed to five stable metabolic products. These metabolites were extracted in ethyl acetate, isolated by column chromatography, and then identified using thin layer chromatography (TLC) and gas chromatography-mass spectrometry (GC-MS). 1-Hydroxypyrene was directly identified by GC-MS, while 4-phenanthroic acid, 1-hydroxy-2-naphthoic acid, phthalic acid, and protocatechuic acid were identified to be present in their derivatized forms (methylated forms and silylated forms). Protocatechuic acid was the end product of pyrene degradation by Armillaria sp. F022. Dynamic profiles of two key enzymes, namely laccase and 1,2-dioxygenase, were revealed during the degradation process, and the results indicated the presence of a complicated mechanism in the regulation of pyrene-degrading enzymes. In conclusion, Armillaria sp. F022 is a white-rot fungus with potential for application in the degradation of polycyclic aromatic hydrocarbons such as pyrene in the environment.